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NATIONAL DAM SAFETY PROGRAM. LAKE INTERVALE DAM (NJ00769), PASS--ETC(U)
MAY 81 R J MCDERMOTT, J E GRIBBIN DACW61-79-C-0011

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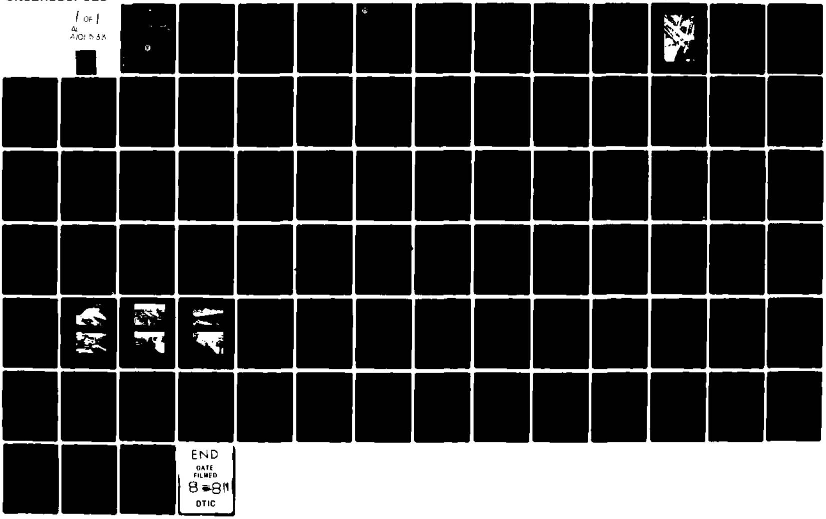

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LEVEL II

PASSAIC RIVER BASIN
TROY BROOK, MORRIS COUNTY
NEW JERSEY

LAKE INTERVALE DAM
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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

REPT. NO: DAEN/NAP-53842/NJ00769-81/05

MAY 1981

National Dam Safety Program. Lake Intervale Dam (NJ00769), Passaic River Basin, Troy Brook, Morris County, New Jersey. Phase I Inspection Report.

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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	3. RECIPIENT'S CATALOG NUMBER
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16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program
Embankments	Lake Intervale Dam, NJ
Visual Inspection	Spillways
Structural Analysis	Erosion

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

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Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

6 JUN 1981

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Intervale Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Intervale Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to ten percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) Trees and adverse vegetation on the dam embankment should be removed.

(2) The eroded area on the downstream side of the embankment should be properly filled and stabilized.

c. When the water level returns to its normal level, the dam and its appurtenances should be inspected for seepage.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

e. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

for Kenneth R Moser Major CE, DE
JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE INTERVALE DAM (NJ00769)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 18 December 1980 by Storch Engineers, under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Intervale Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to ten percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) Trees and adverse vegetation on the dam embankment should be removed.

(2) The eroded area on the downstream side of the embankment should be properly filled and stabilized.

c. When the water level returns to its normal level, the dam and its appurtenances should be inspected for seepage.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

e. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED: Kenneth R Moss Maj C.E, DC
JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

DATE: 2 July 1981

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Intervale Dam, I.D. NJ00769
State Located:	New Jersey
County Located:	Morris
Drainage Basin:	Passaic River
Stream:	Troy Brook
Date of Inspection:	December 18, 1980

Assessment of General Condition of Dam

Based on visual inspection, past operational performance and Phase I engineering analyses, Lake Intervale Dam is assessed as being in good overall condition.

Based on investigations of the downstream flood plain made in connection with this report, it is recommended that the hazard potential classification be downgraded from high to significant hazard.

Hydraulic and hydrologic analyses indicate that the spillway is inadequate. Discharge from the spillway is not sufficient to pass the designated spillway design flood (100-year storm) without an overtopping of the dam. The spillway is capable of passing approximately 9 percent of the SDF. Therefore, the owner should engage a professional engineer experienced in the design and construction of dams in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of the analyses, the need for, and the type of remedial measures should be determined and then implemented.

The owner should, in the near future, develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam.

Also, when the water level returns to its normal level, the dam and its appurtenances should be inspected for seepage. (Lake water level was drawn down at the time of inspection.)

In addition, it is recommended that the following remedial measures be undertaken by the owner in the near future.

1) Trees and adverse vegetation on the dam embankment should be removed.

2) The eroded area on the downstream side of the embankment should be properly filled and stabilized.

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

Richard J McDermott

Richard J. McDermott, P.E.

John E Gribbin

John E. Gribbin, P.E.

OVERVIEW - LAKE INTERVALE DAM

20 JANUARY 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydraulic and hydrologic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydraulic and hydrologic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

LAKE INTERVALE DAM, I.D. NJ00769

SECTION 1: PROJECT INFORMATION

1.1 General

a. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Lake Intervale Dam was made on December 18, 1980. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description

The dam is an earth embankment with a concrete spillway structure fitted with a timber stoplog. A concrete core wall extends along the embankment for a portion of its length and a timber bridge spans the spillway structure.

The outlet works consist of a gated 12" transite pipe which transversely penetrates the dam embankment to the left of the spillway. The outlet discharges into the downstream channel at a point approximately 50 feet downstream of the dam.

The crest and downstream face of the dam is stabilized by grass while the upstream face is covered with grass and brush. The left portion of the embankment, for a distance of about 400 feet, consists of a paved parking area.

The elevation of the spillway crest is 378.0 National Geodetic Vertical Datum (N.G.V.D.) while that of the crest of dam is 380.9. The elevation of the invert of the outlet works is 373.5 while that of the channel bed at the spillway is 374.7. The overall length of the dam is 520 feet and its height is 6.2 feet.

b. Location

Lake Intervale Dam is located in the Township of Parsippany-Troy Hills, Morris County, New Jersey. It impounds a recreational lake known as Lake Intervale, adjacent to Lake Drive which provides principal access. Discharge from the spillway of the dam flows into a branch of the Troy Brook.

c. Size and Hazard Classification

The dam is classified in accordance with criteria presented in "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers. Size categories consist of Small, Intermediate and Large while hazard categories are designated as Low, Significant and High.

Size Classification: .Lake Intervale Dam is classified as "Small" size since its maximum storage volume is 89 acre-feet (which is less than 1000 acre-feet) and its height is 6.2 feet (which is less than 40 feet).

Hazard Classification: Visual inspection of the downstream flood plain of the dam together with breach analysis indicate that failure of the dam due to overtopping would not cause inundation of the dwellings downstream from the dam. Failure due to overtopping could result in damage to the road bridge located 150 feet from the dam as well as to the beach and parking area located on the dam. Loss of a few lives is possible. Accordingly, Lake Intervale Dam is classified as "Significant" hazard.

d. Ownership

Lake Intervale Dam is owned and operated by the Lake Intervale Management Association, P.O. Box 221, Boonton, New Jersey 07005.

e. Purpose of Dam

The purpose of the dam is the impoundment of a recreational lake facility for the Lake Intervale Management Association.

f. Design and Construction History

Reportedly, Lake Intervale Dam was constructed in the late 1940's by a private developer. In 1960 the Lake Intervale Management Association was formed and acquired ownership and responsibility for the dam and its appurtenances.

Reportedly, plans for the dam as it related to the original subdivision are on file with the Township of Parsippany-Troy Hills.

g. Normal Operational Procedures

The dam and appurtenances are maintained by the Grounds Committee of the Lake Intervale Management Association. There is no fixed schedule of maintenance; repairs are made as the need arises.

The outlet works, constructed in 1979, reportedly is used to drain the lake for lake maintenance purposes.

The lake was last lowered through the outlet works in September 1979 in order to facilitate dredging operations by the Grounds Committee.

1.3 Pertinent Data

a. Drainage Area — 0.53 square miles

b. Discharge at Damsite

Maximum flood at damsite	Unknown
Outlet Works at pool elevation	10 cfs.
Spillway capacity at top of dam	67 cfs

c. Elevation (N.G.V.D.)

Top of Dam	380.9
Maximum pool-design surcharge	381.8
Recreation pool	378.7
Spillway crest	378.7
Stream bed at centerline of dam	374.4
Maximum tailwater	377 (Estimated)

d. Reservoir

Length of maximum pool	850 feet (Estimated)
Length of recreation pool	750 feet (Scaled)

e. Storage (Acre-feet)

Recreation pool	46
Design surcharge	114
Top of dam	89

f. Reservoir Surface (acres)

Top of dam	19.1 (Estimated)
Maximum pool - design surcharge	20.0 (Estimated)
Recreation pool	10.1

g. Dam

Type	Earthfill/Concrete Core
Length	520 feet
Height	6.2 feet
Sideslopes - Upstream	3 horiz. to 1 vert.
- Downstream	3 horiz. to 1 vert.
Zoning	Unknown
Impervious core	Concrete Core Wall

Cutoff	Unknown
Grout curtain	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Concrete Sharp Crested Weir
Length of weir	6.0 feet
Crest elevation	378.7
Gates	Timber Stoplog
Upstream channel	Concrete Lined Channel
Downstream channel	Natural stream

j. Regulating Outlet

12" diameter gated transite pipe.

SECTION 2: ENGINEERING DATA

2.1 Design

No plans or calculations pertaining to the original construction of the dam could be obtained. Drawings prepared in or about 1950 relating to a proposed subdivision which show a plan of the lake reportedly are on file with the Township of Parsippany-Troy Hills.

2.2 Construction

No data or reports pertaining to the construction of the dam are available.

2.3 Operation

Reportedly, informal maintenance reports are on file with the Lake Intervale Management Association.

Data relating to Stream Encroachment Application to the NJDEP for dredging of the lake are available at the NJDEP.

2.4 Evaluation

a. Availability

Available engineering data is limited to that which is on file with the Township of Parsippany-Troy Hills and the NJDEP. The files contain drawings relating to a proposed subdivision. Also, the NJDEP has Stream Encroachment Permit No. 9503 on file which include plans for the current dredging of the lake.

b. Adequacy

Available engineering data pertaining to Lake Intervale Dam is not adequate to be of significant assistance to the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

The validity of engineering data cannot be assessed due to the absence of data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Lake Intervale Dam was performed on December 18, 1980 by staff members of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1) The embankment of the dam, appurtenant structures and adjacent areas were examined.
2) The embankment and accessible appurtenant structures were measured and key elevations determined by surveyor's level.
3) The embankment, appurtenant structures and adjacent areas were photographed.
4) The downstream flood plain was toured to evaluate downstream development and restricting structures.

b. Dam

The right portion of the dam having a length of about 120 feet was generally grass covered with a few trees on its downstream side with sizes of 12 inches to 18 inches and a few trees on its upstream side with sizes about 6 inches. Bushes were also noted on the upstream side. The left portion of the dam, having a length of about 400 feet, was formed by the parking area for a swim club. The area was mostly paved and contained a few small trees on its downstream side. Immediately downstream from the parking area was a paved public road.

The concrete slope protection adjacent to each side of the spillway was in generally satisfactory condition. An eroded area observed adjacent to the slope protection on the downstream side appeared to be the result of pedestrian activity.

c. Appurtenant Structures

Concrete surfaces on the spillway structure appeared to be in satisfactory condition. A high water mark noted on the upstream training walls indicated that normal water level is at the top of the observed stoplog. The stoplog appeared to be in generally satisfactory condition, although the rubber strip along its lower edge is somewhat deteriorated and starting to separate from the wood. A temporary plastic pipe was observed in place in the spillway, apparently used in connection with the dewatering of the lake by pumping. The condition of the footbridge spanning the spillway appeared to be good. The wood appeared to be recent and the chain link fence railing appeared to be in good condition.

The upstream end of the outlet pipe was observed protruding from the embankment and the downstream end was observed protruding from the bank of the downstream channel. No gate operating mechanism was observed.

A 15-inch concrete pipe was observed protruding through the right bank of the downstream channel immediately downstream from the spillway structure. The function of the pipe could not be assessed.

d. Reservoir Area

The reservoir was almost completely surrounded by home sites, most including lake related structures such as walls and docks. The portion of the reservoir shore near the left section of the dam consisted of a swimming area and beach.

Extensive dredging operations were in progress at the time of inspection. The lake was drawn down by use of pumps at the time of inspection.

e. Downstream Channel

The downstream channel between the spillway and the Lake Drive bridge consisted of a natural stream with approximately 3 to 4 foot high banks with a few small trees and bushes growing along the banks. The bottom could not be observed because a stilling basin had been created by the placement of boards just upstream from the bridge in connection with the pumping operations. Downstream from the bridge the downstream channel was a straight, uniformly graded stream extending along the rear property lines of the downstream dwellings. It had sideslopes of approximately 2 to 1 and it had a few small trees growing in the side slopes. Its banks were rather high, approximately 6 to 10 feet. The dwellings on either side of the downstream channel were about 10 feet above the invert and appeared to be slightly below the top of the dam.

The confluence of the downstream channel and the Troy Brook is approximately 500 feet downstream of the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Lake Intervale is normally regulated by discharge through the spillway structure. At the time of inspection the lake was in a drawn down condition for the purpose of dredging. Reportedly, the stoplog is installed for the summer months and removed during the winter. In this manner the level of water varies from approximately elevation 378.0 to 378.8 in winter and summer respectively.

The most recent drawdown of the lake occurred in 1979 when the Lake Intervale Management Association siphoned the lake down a total of approximately twenty feet in order to perform dredging operations.

The stoplog has not been in place since September 1979 when the lake was lowered for the purpose of dredging. The lake was drawn down in September 1979 in about 4 days with the 12-inch transite low level outlet works. It was then drawn down to an elevation 15 feet below the normal low level pool by use of by-pass pumping which remained in use until dredging operations were reportedly completed on December 31, 1980.

4.2 Maintenance of the Dam

Reportedly, maintenance is performed on an "as needed" basis. The Lake Intervale Management Association Grounds Committee inspects the dam on a yearly basis and performs repairs, if necessary.

The timber foot bridge was reportedly repaired in the summer of 1980.

4.3 Maintenance of Operating Facilities

Reportedly, the 12-inch transite outlet works was constructed in 1978 and functions properly. It was not physically operated as part of this inspection.

4.4. Description of Warning System

Reportedly, no warning system is currently in use for the dam.

4.5 Evaluation of Operational Adequacy

The operation of the dam has been successful to the extent that the dam reportedly has not been overtopped.

Although maintenance has been good in some areas, some aspects of dam maintenance have not been adequately performed, including the following:

1) Clusters of small trees and brush on the embankment not removed.
2) Eroded area on downstream side of embankment not repaired.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The quantity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff quantity, called the spillway design flood (SDF), is described in terms of return frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers, the SDF for Lake Intervale Dam falls in a range of 100-year frequency to 1/2 PMF. In this case, the low end of the range, 100-year frequency, is chosen since the factors used to selct size and hazard classification are on the low side of their respective ranges.

The SDF peak computed for Lake Intervale Dam is 713 c.f.s. This value is derived from the 100-year flood hydrograph computed by the use of the HEC-1-DAM Flood Hydrograph Computer Program using the Soil Conservation Service triangular unit hydrograph with curvilinear transformation. Hydrologic computations and computer output are contained in Appendix 4.

The spillway discharge rates were computed by the use of weir and orifice flow formulae appropriate for the configuration of the spillway structure. The total spillway discharge with lake level equal to the top of the dam was computed to be 67 c.f.s. The SDF was routed through the dam by use of the HEC-1-DAM computer program using the modified Puls Method. In routing the SDF, it was found that the dam crest would be

overtopped by a depth of 0.9 foot. Accordingly, the subject spillway is assessed as being inadequate in accordance with criteria developed by the U.S. Army Corps of Engineers.

A dam breach analysis was then performed using a trapezoidal breach section with bottom length of 25 feet and sideslopes of 1 horizontal to 1 vertical. The breach peak outflow was computed to be 1340 c.f.s. Dam breach computations are contained in Appendix 4.

b. Experience Data

Reportedly, the dam has not been overtopped since its construction.

c. Visual Observation

No evidence was found at the time of inspection that would indicate that the dam had been overtopped.

d. Overtopping Potential

As indicated in paragraph 5.1.a. a storm of magnitude equal to the SDF would cause overtopping of the dam by a depth of 0.9 foot over the crest of the dam. The spillway is capable of passing approximately 9 percent of the SDF with the lake level equal to the top of dam.

e. Drawdown Data

Drawdown of the lake is accomplished by opening the gated 12-inch outlet pipe. Total time for drawdown is estimated to be approximately 3 days. (See Appendix 4.)

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The dam appeared, at the time of inspection to be outwardly structurally sound with no evidence of embankment cracks or distress. No evidence of seepage was observed. Due to the extremely drawndown condition of the dam, a seepage evaluation cannot be performed.

b. Generalized Soils Description

The generalized soils description of the dam site consists of recent alluvium, composed of stratified materials deposited by streams, overlying glacial ground moraine deposited during the Wisconsin Glaciation. The glacial moraine and kames are composed of silts and silty sands and overlie shale and sandstone known as the Brunswick Formation in the Geologic Map of New Jersey prepared by Lewis and Kummel.

c. Design and Construction Data

Analysis of structural stability and construction data for the embankment are not available.

d. Operating Records

No operating records are available for the dam. The water level of Lake Intervale is not monitored.

e. Post-Construction Changes

The major post-construction change at the dam site is the extensive removal of soil from the bottom of Lake Intervale. Lake dredging operations with the lake drawn down were in progress at the time of inspection.

f. Seismic Stability

Lake Intervale Dam is located in Seismic Zone 1 as defined in "Recommended Guidelines for Safety Inspection of Dams" which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if they have adequate stability under static loading conditions. Lake Intervale Dam appeared to be stable at the time of inspection.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillway of Lake Intervale Dam is assessed as being inadequate. The spillway is not able to pass the SDF without an overtopping of the dam.

The embankment appeared, at the time of inspection, to be outwardly stable.

b. Adequacy of Information

Information sources for this report include 1) field inspections, 2) USGS quadrangle, and 3) consultation with personnel of the Lake Intervale Management Association. The information obtained is sufficient to allow a Phase I assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some of the absent data are as follows:

1. Construction and as-built drawings.
2. Description of fill material for embankment.
3. Design computations and reports.
4. Soils report for the site.
5. Inspection reports.

c. Necessity for Additional Data/Evaluation

Although some data pertaining to Lake Intervale are not available, additional data are not considered imperative for this Phase I evaluation.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a, the spillway is considered to be inadequate. It is therefore recommended that a professional engineer experienced in the design and construction of dams be engaged in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of these analyses, the need for and type of remedial measures should be determined and then implemented.

In addition, it is recommended that the following remedial measures be undertaken by the owner in the near future.

1) Trees and adverse vegetation on the dam embankment should be removed.
2) The eroded area on the downstream side of the embankment should be properly filled and stabilized.

b. Maintenance

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

c. Additional Studies

When the water level returns to its normal level, the dam and its appurtenances should be inspected for seepage.

PLATES

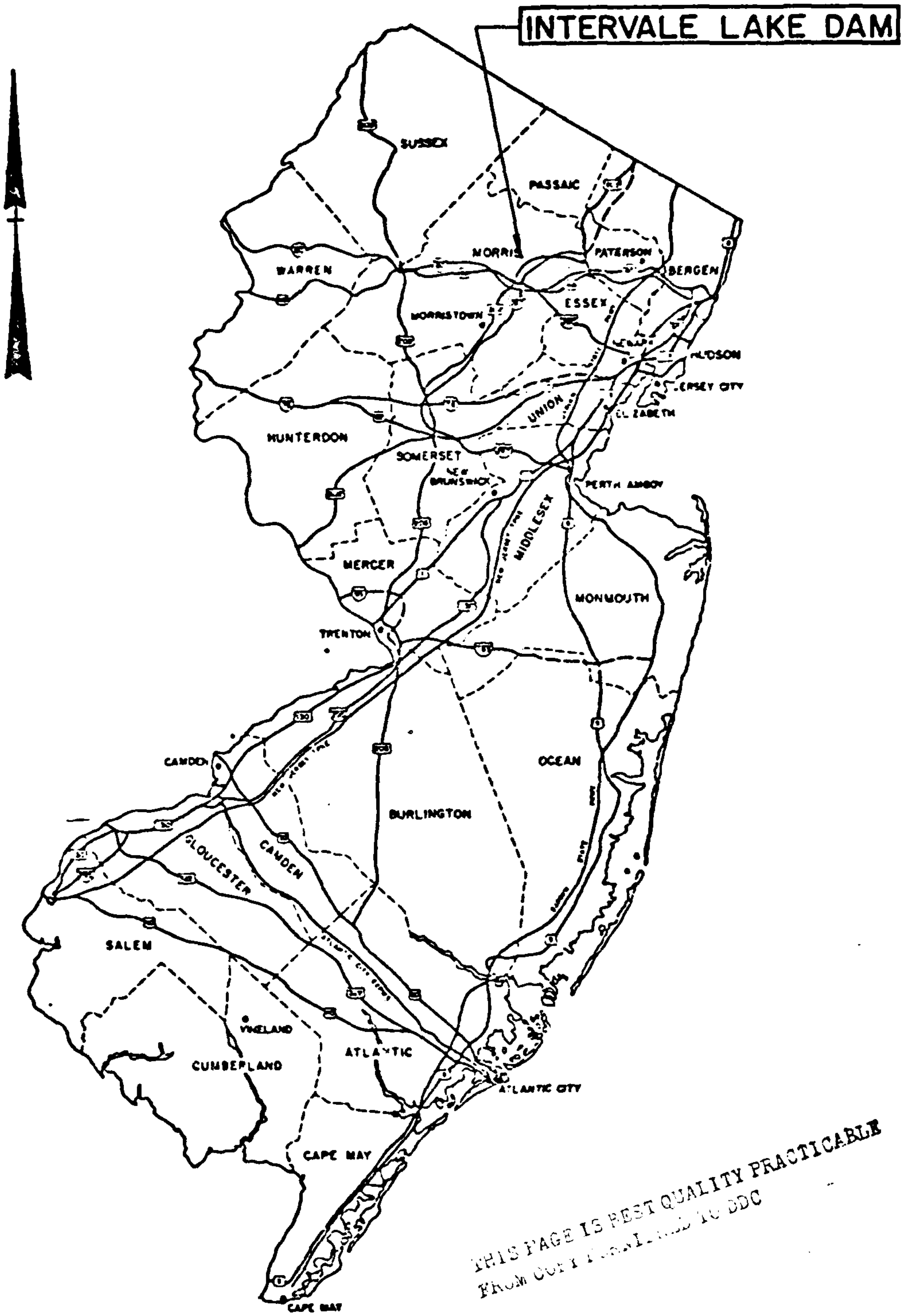


PLATE 1

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

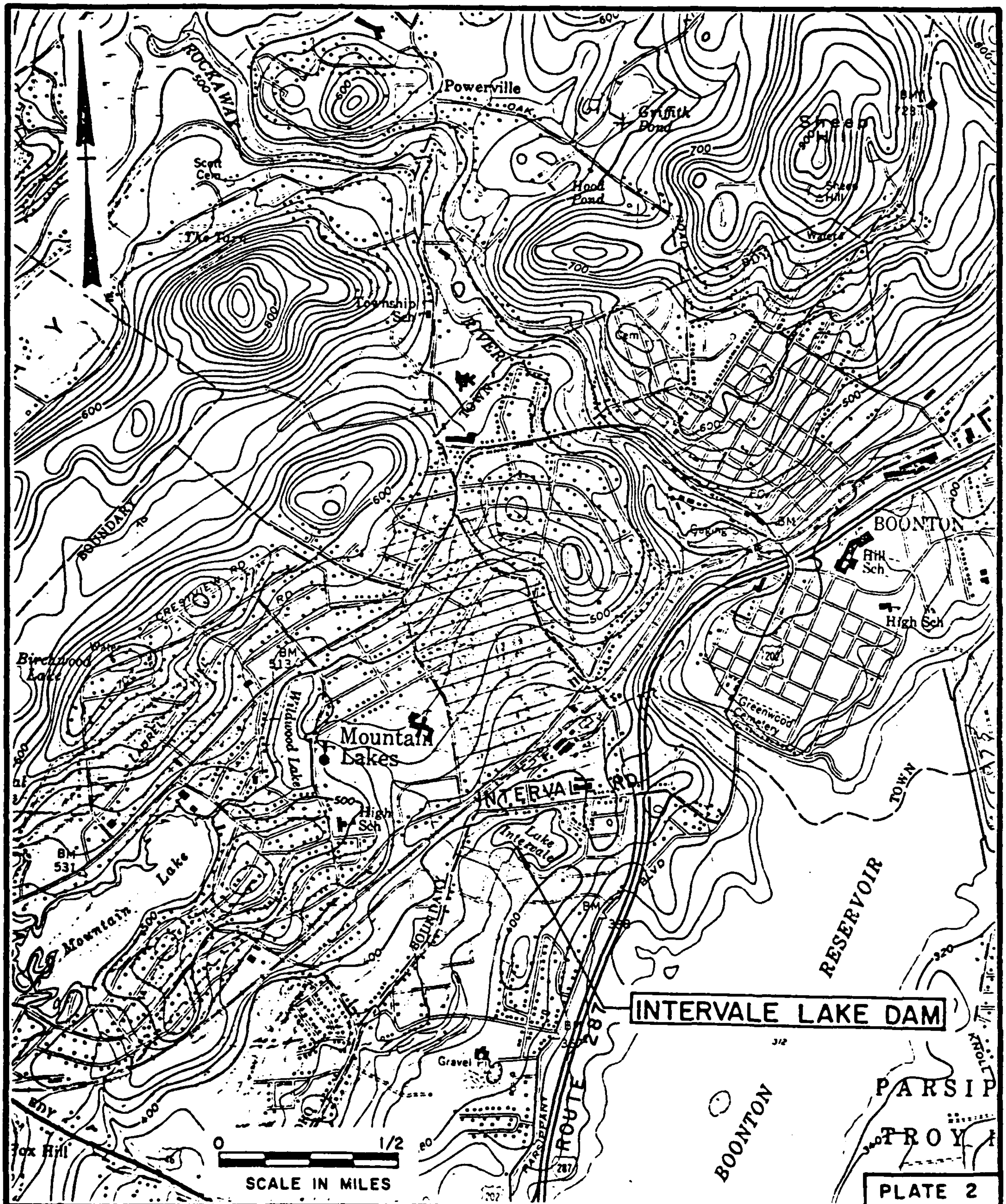
INSPECTION AND EVALUATION OF DAMS

KEY MAP

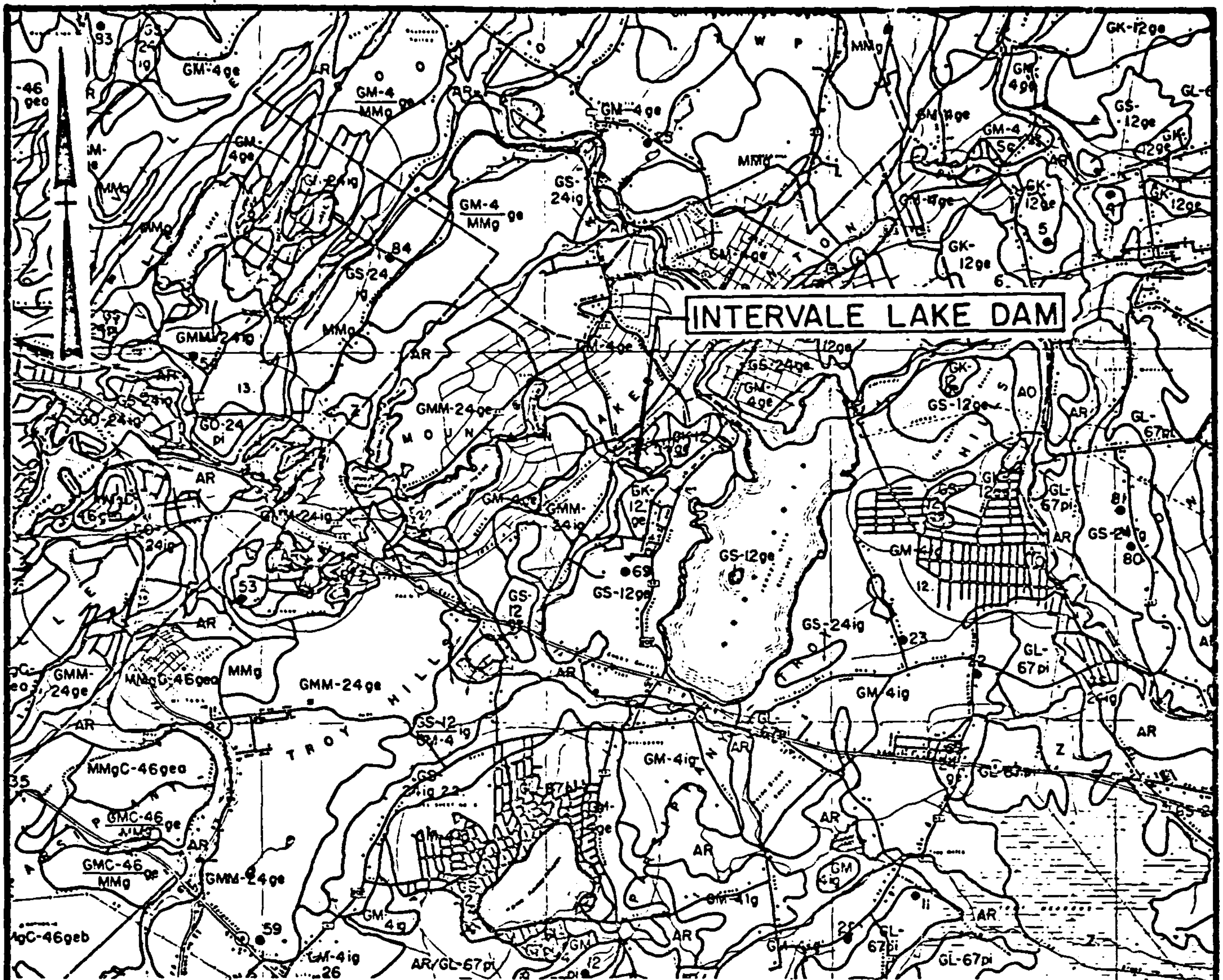
INTERVALE LAKE DAM

SCALE: NONE

DATE: FEB. 1981



STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS **VICINITY MAP** INTERVALE LAKE DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	SCALE: AS SHOWN DATE: FEB. 1981

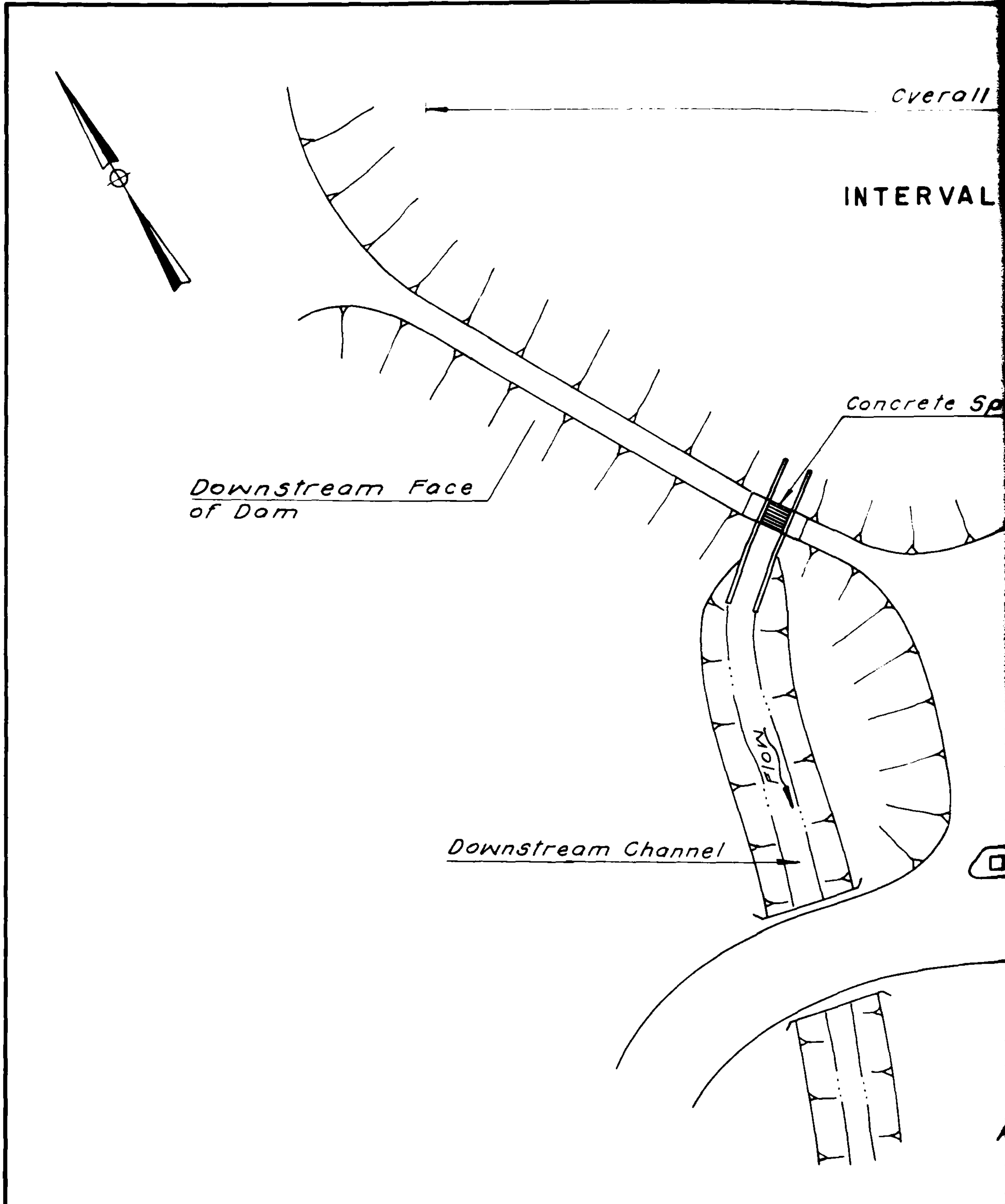


Legend

AR	Recent alluvium; composed of stratified materials deposited by streams.
GK-12	Glacial kames; composed of stratified materials deposited during the Wisconsin glacial period.
GM-4	Glacial ground moraine; composed of unstratified material deposited during the Wisconsin glaciation.
Note:	Information taken from: Rutgers University Engineering Soil Survey of New Jersey, Report No. 9, Morris County, November 1953 and Geologic Map of New Jersey prepared by J. V. Lewis and H. Kummel 1910-1912, revised by H. B. Kummel 1931 and M. Johnson 1950.

PLATE 3

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS **SOIL MAP** INTERVALE LAKE DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	SCALE: NONE DATE: FEB. 1981



Notes:
1. Information taken from field inspection December 18, 1980
2. Dredging operations in progress at time of inspection.

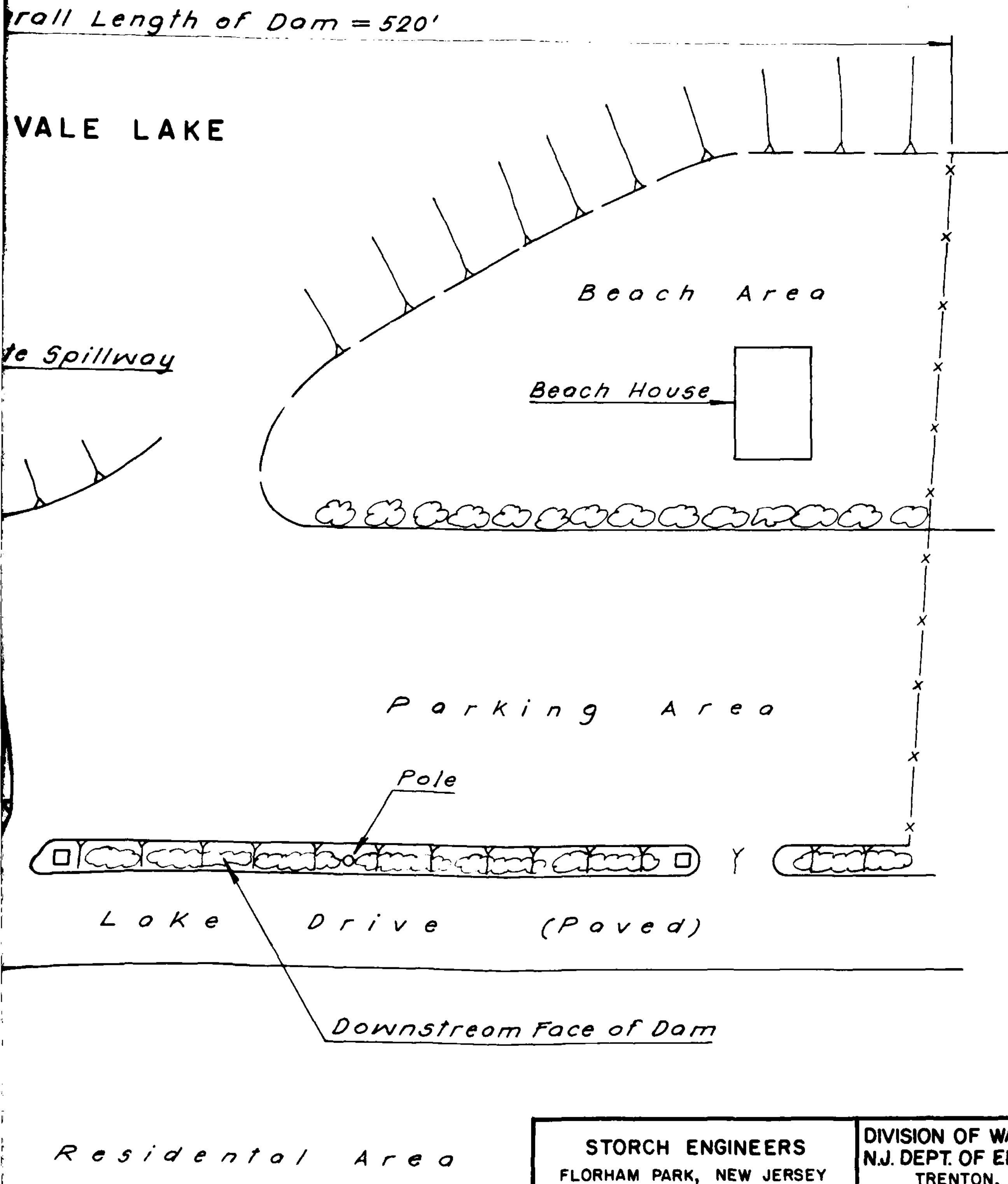


PLATE 4

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

GENERAL PLAN
LAKE INTERVALE DAM

I.D.N.J. 00769	SCALE: NOT TO SCALE
	DATE: MARCH 1981

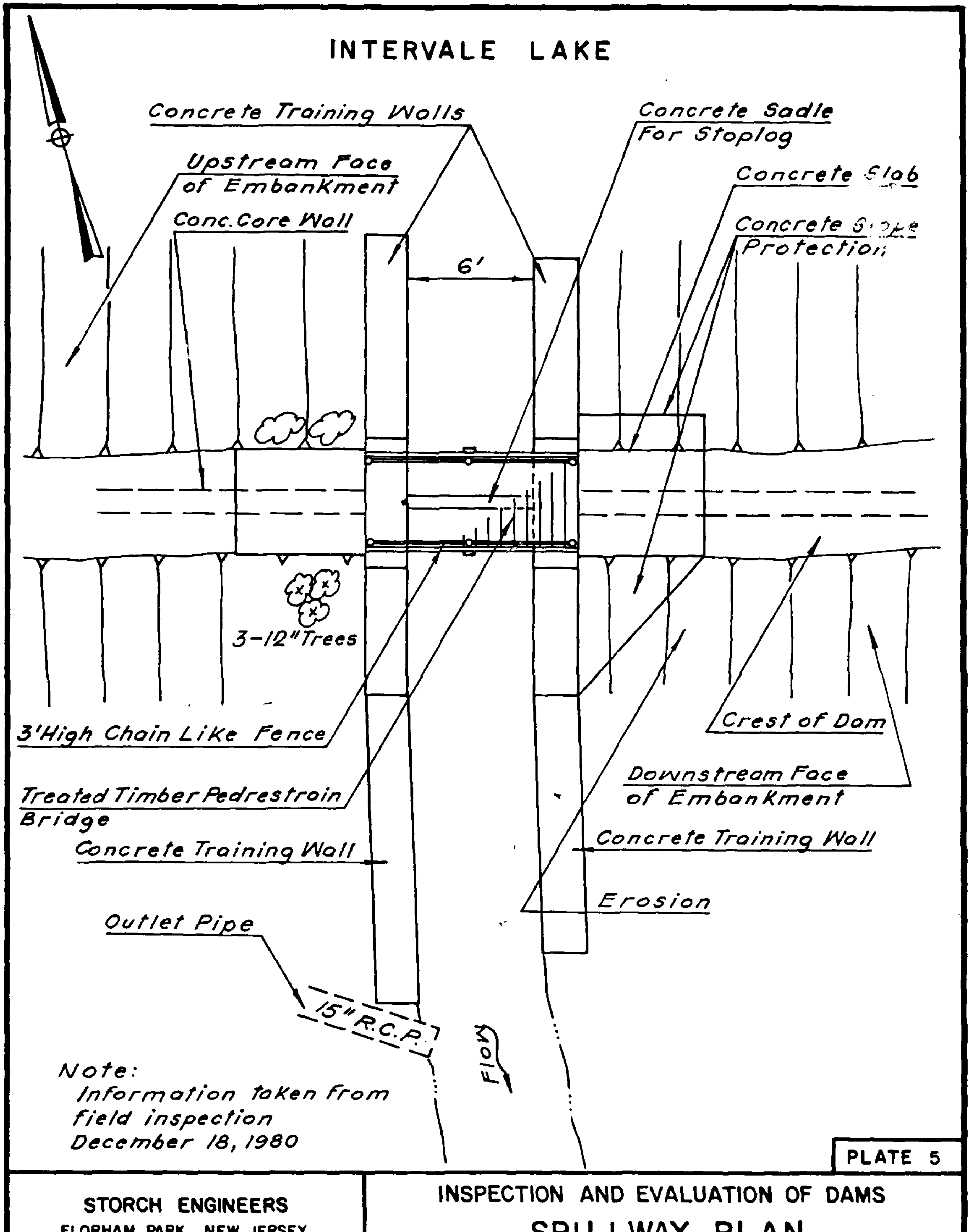
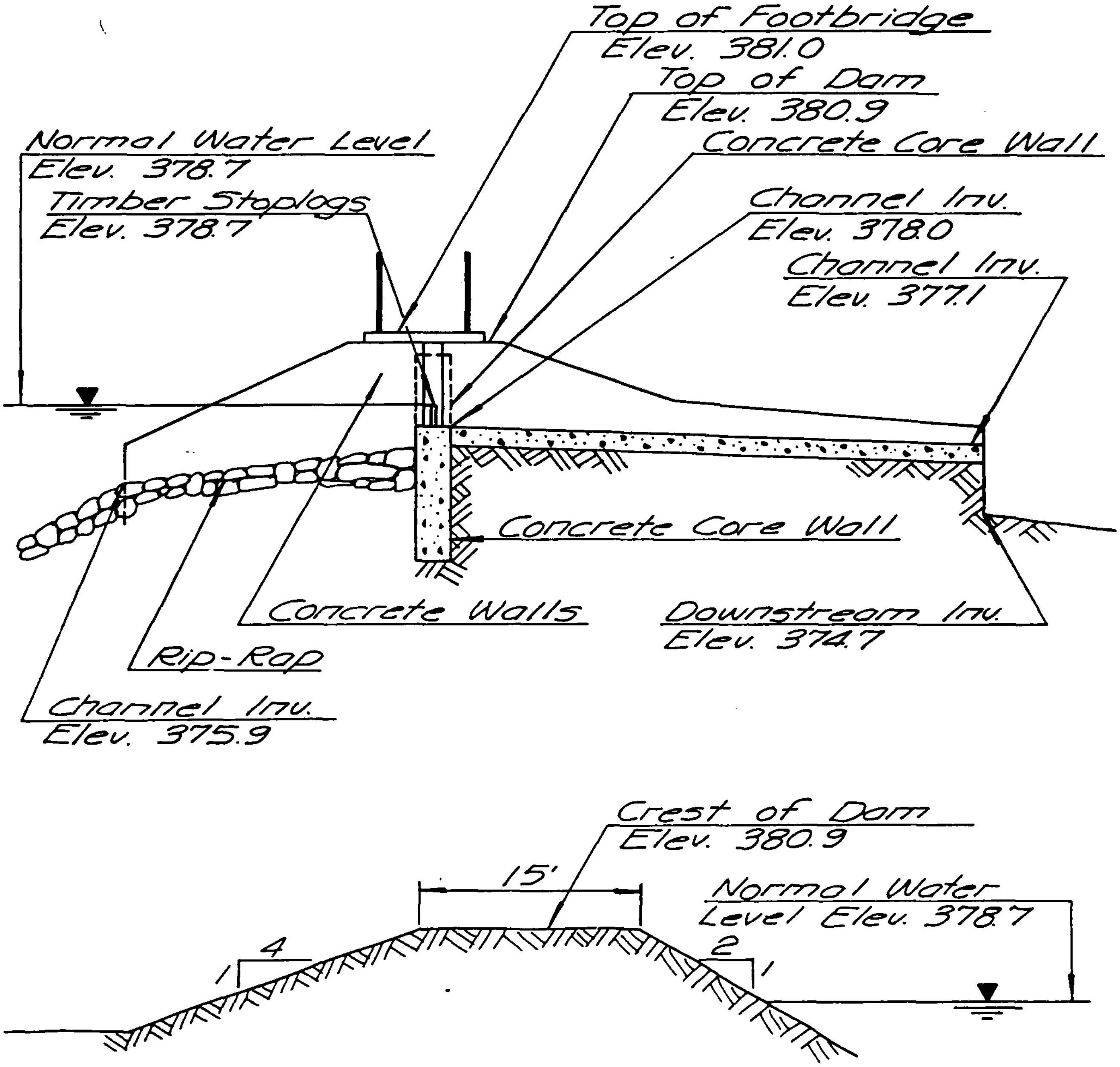


PLATE 5

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS SPILLWAY PLAN LAKE INTERVALE DAM	
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. N.J. 00769	SCALE: NONE DATE: MARCH, 1981



NOTES:

1. Information taken from field Inspection December 18, 1980.
2. Lake was drawn down at time of Inspection.

PLATE 6

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

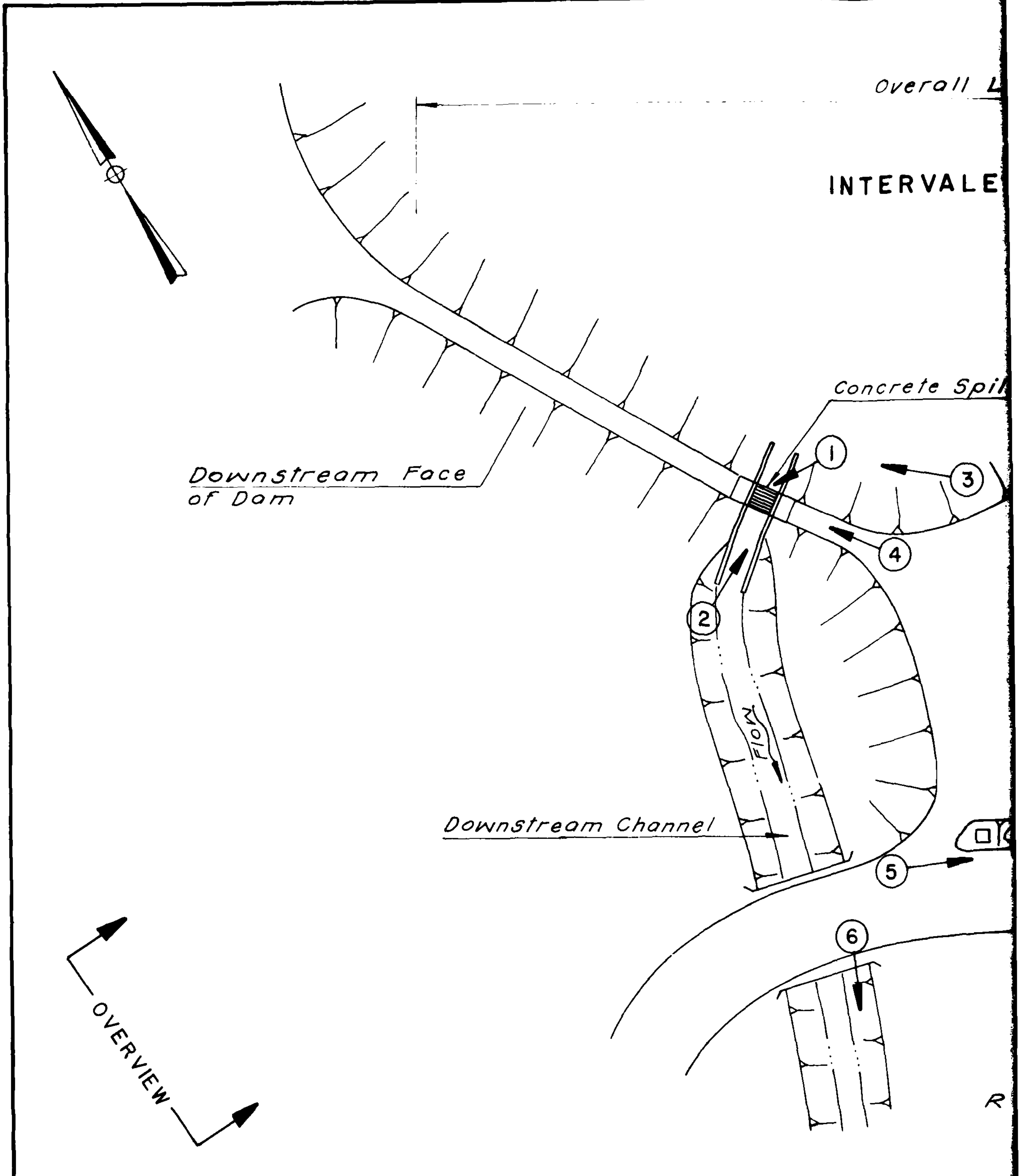
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

SECTIONS

LAKE INTERVALE DAM

I.D. N.J. 00769	SCALE: NONE
	DATE: MARCH, 1981



Notes:
1. Information taken from field inspection December 18, 1980
2. Dredging operations in progress at time of inspection.

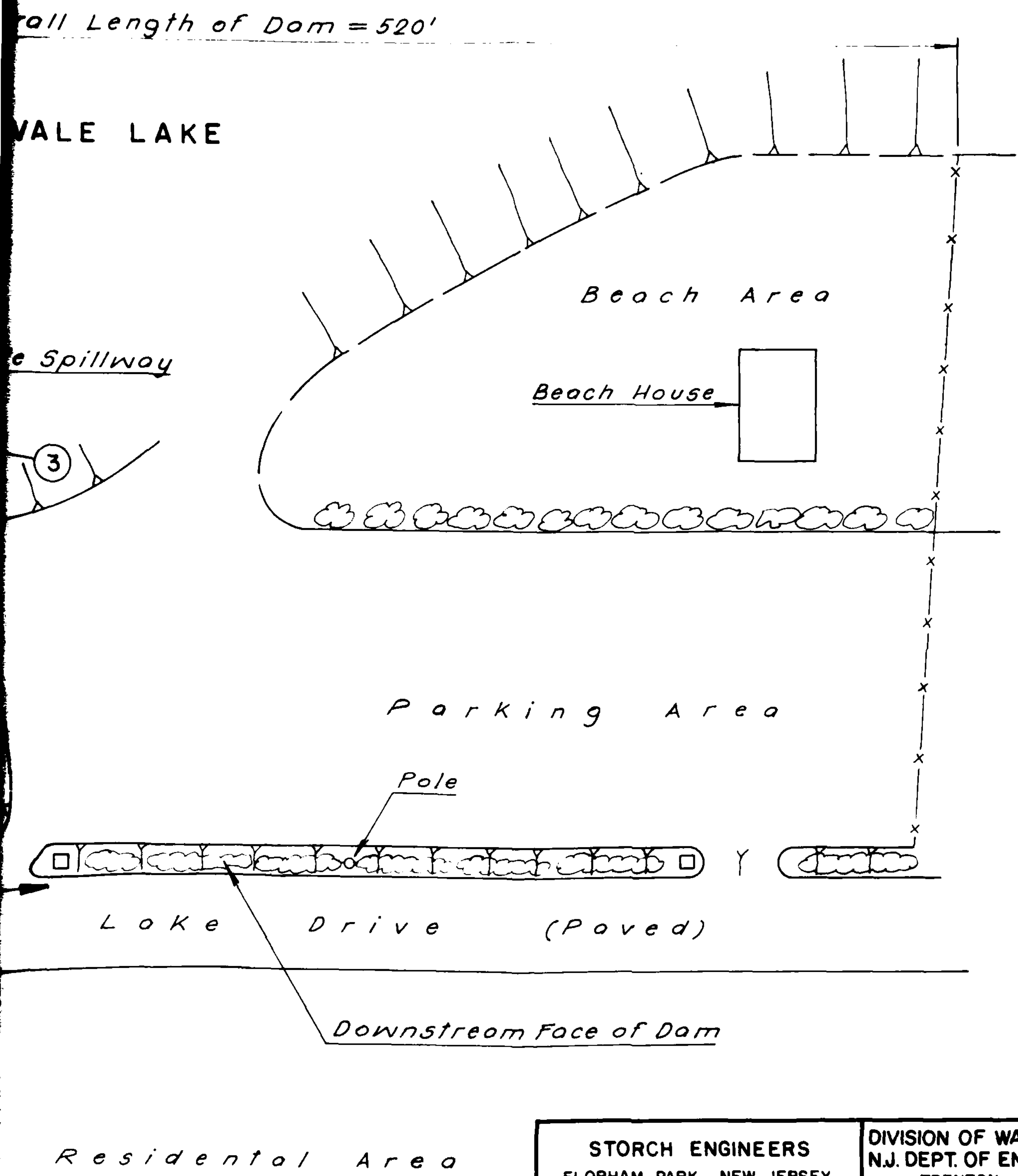


PLATE 7

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN
LAKE INTERVALE DAM

I.D.N.J.00769	SCALE: NOT TO SCALE
	DATE: MARCH 1981

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List

Visual Inspection

Phase I

Name of Dam Lake Intervale Dam County Morris State N.J. Coordinators NJDEP

Date(s) Inspection 12/18/80 Weather Cloudy Temperature 30^{o}F

Pool Elevation at time of Inspection 345 (approx.) M.S.L. Tailwater at Time of Inspection 373.5 M.S.L.
(Lake dredged & drawn down)

Inspection Personnel:

John Gribbin	Andrew Polperio	
Charles Osterkorn	Richard McDermott	
Daniel Buckelew		

John Gribbin Recorder

Owner not present.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Right section of embankment generally grass covered with a few trees (12" to 18") on downstream side and bushes and a few trees (6") on upstream side. Most of left section of embankment paved (parking area) with a few small trees on downstream side.	Trees should be removed.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Junctions appeared stable.	
ANY NOTICEABLE SEEPAGE	None observed	Lake drawn down: Seepage not possible under draw down condition.
STAFF GAGE AND RECORDER	None observed	
DRAINS	Outlet end of 15" conc. pipe observed protruding through right bank of downstream channel immediately downstream from spillway structure.	Function of pipe could not be assessed. Pipe could possibly be toe drain for right portion of embankment.

EMBANKMENT

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No sloughing observed. Erosion observed on downstream side of embankment adjacent to conc. slope protection. Erosion appeared to be caused by pedestrian activity.	Eroded area should be filled and properly stabilized.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical: varies Horizontal: irregular	
RIPRAP	None observed. Conc. slab slope protection observed on crest adjacent to spillway and on upstream and downstream side left of spillway for distance of 5' appeared to be in satisfactory condition.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES IN OUTLET CONDUIT	12 inch transite pipe generally could not be observed. Discharge end protruding through bank of downstream channel appeared in generally satisfactory condition.	
INTAKE STRUCTURE	Not observed.	
OUTLET STRUCTURE	N.A.	
OUTLET CHANNEL	Outlet works discharge directly into downstream channel.	
GATE AND GATE HOUSING	Not observed.	

SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
WEIR	Timber stoplog forming weir in generally satisfactory condition with rubber seal deteriorated. Conc. saddle upon which stoplog rests was in satisfactory condition.	Stoplog not functioning at time of inspection due to draw down condition of lake. Stoplog should be repaired.
TRAINING WALLS	Appeared in satisfactory condition.	
DISCHARGE CHANNEL	Formed by cond. training walls appeared in satisfactory condition.	
BRIDGE	Timbers forming pedestrian bridges appeared in good condition. Chain link fence railings also in good condition.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Shore slopes are moderate to flat. Area is completely developed for residential use.	
SEDIMENTATION	None. Extensive dredging operations in progress at time of inspection. Invert of lake appeared about 30' below dam crest. Lake draw down by pumps at time of inspection.	
STRUCTURES ALONG BANKS	Homesites were observed around entire lake area. Homesites included lake related structures such as walls and docks.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTION, DEBRIS, ETC.)	Channel is well graded and straight. Temporary timber weir was in place immediately upstream from road bridge. Weir appeared to be related to dredging and pumping operations.	Discharge from pumping of lake entered downstream channel.
SLOPES	Both banks had slopes of about 2 horiz. to 1 vert. and were about 6 to 10 feet high.	
STRUCTURES ALONG BANKS	Road bridge about 150' downstream. Several dwellings adjacent to channel downstream from bridge, min. 8' above stream invert.	Channel extends along rear property lines of homesites.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM		REMARKS
DAM -	PLAN	Available in NJDEP Files - Stream Encroachment Permit #9503
	SECTIONS	
SPILLWAY -	PLAN	Not Available
	SECTIONS	
	DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS		
OUTLETS -	PLAN	Not Available
	DETAILS	
	CONSTRAINTS	
	DISCHARGE RATINGS	
HYDRAULIC/HYDROLOGIC DATA		Not Available
RAINFALL/RESERVOIR RECORDS		Not Available
CONSTRUCTION HISTORY		Not Available
LOCATION MAP		Available in DEP files. Drawings prepared in or about 1950 relating to proposed subdivision show a plan of the lake, on file with the Township of Parsippany-Troy Hills.

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM INSTABILITY SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not Available
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	

ITEM	REMARKS
MONITORING SYSTEMS	Not Available
MODIFICATIONS	Not Available
HIGH POOL RECORDS	Not Available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Stream Encroachment Application-NJDEP files
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Not Available
MAINTENANCE OPERATION RECORDS	Informal maintenance reports on file with the Lake Intervale Management Association

APPENDIX 2

Photographs

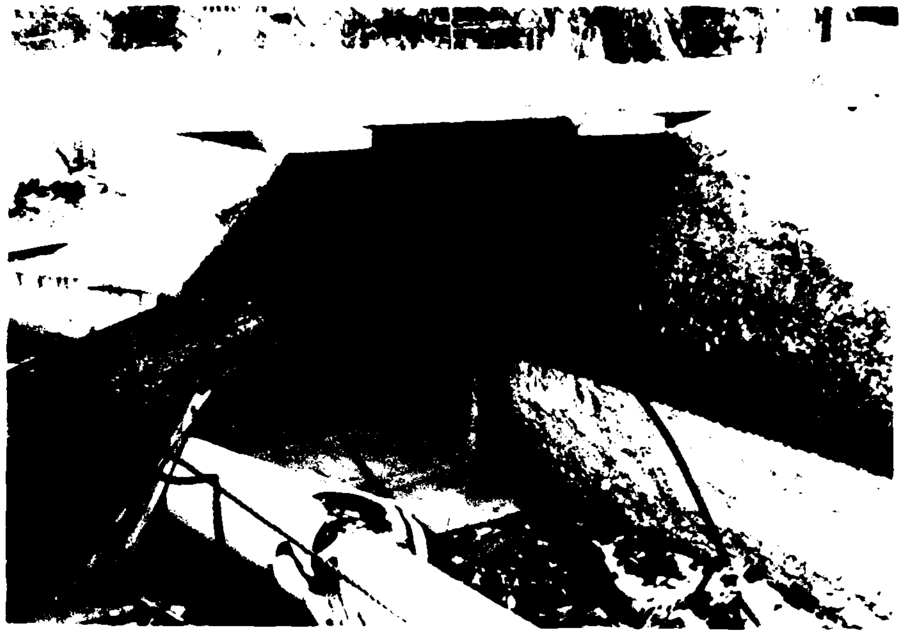


PHOTO 1

CREST AND RIGHT TRAINING WALL OF SPILLWAY

PHOTO 2

DOWNSTREAM SIDE OF SPILLWAY

LAKE INTERVALE DAM

18 DECEMBER 1980

PHOTO 3

UPSTREAM SIDE OF DAM AND SPILLWAY

PHOTO 4

CREST OF DAM

LAKE INTERVALE DAM

18 DECEMBER 1980

PHOTO 5

DOWNSTREAM SIDE OF DAM-LEFT SECTION

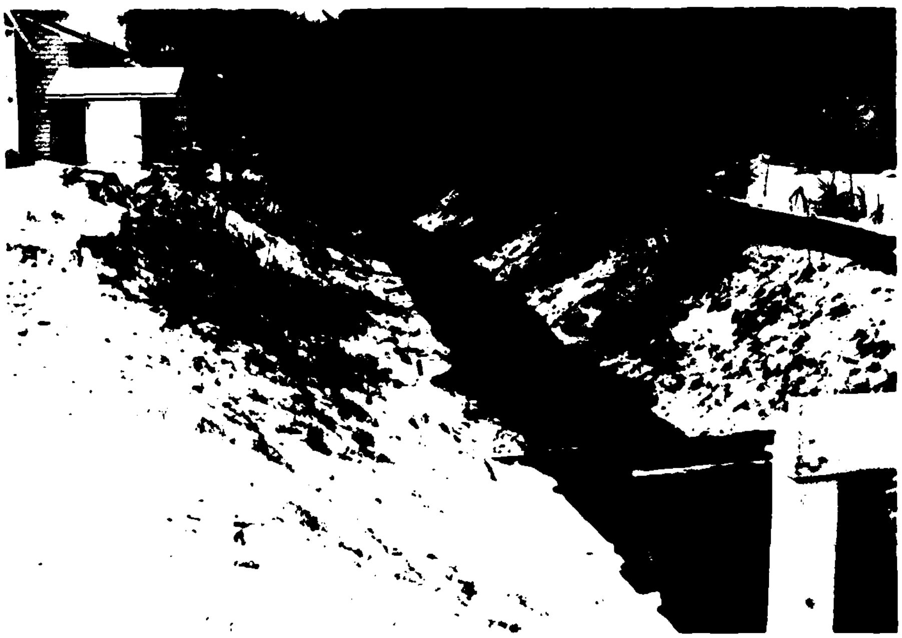


PHOTO 6

DOWNSTREAM CHANNEL

LAKE INTERVALE DAM

18 DECEMBER 1980

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Residential

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 378.7 (46 acre-ft)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 381.8

ELEVATION TOP DAM: 380.9

SPILLWAY CREST: Controlled Weir (Stoplogs)

a. Elevation 378.7

b. Type Sharp Crested Weir

c. Width 0.1 feet

d. Length 6.0 feet

e. Location Spillover Center of dam

f. Number and Type of Gates One stoplog

OUTLET WORKS:

a. Type Gated 12-inch Transite Pipe

b. Location Left of the Spillway

c. Entrance Invert 374.0

d. Exit Invert 374.0

e. Emergency Draindown Facilities: Remove Stoplog and open gate

HYDOMETEOROLOGICAL GAGES: None

a. Type N/A

b. Location N/A

c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake Stage Equal to Top of Dam) 67 c.f.s.

APPENDIX 4

Hydraulic/Hydrologic Computations

STORCH ENGINEERS

Project INTERVALE LAKE DAM Made By JLP Date 2-25-81

Chkd By JG Date 2/27/81

SQUARE 4 X 4 TO THE INCH

HYDROLOGY

Hydrologic Analysis

Runoff hydrograph will be developed by HEC-1-DAM using SCS triangular hydrograph with the curvilinear transformation

Drainage AREA = 0.53 sq. mi.

Infiltration Data

Initial Infiltration	1.5 in.
Constant Infiltration	0.15 in./hr.

Time of Concentration (t_c) (Method #1)

By SCS TR-55 Chart on Overland flow and channel flow.

OVERLAND FLOW:

L = 6,000'

Δ ELEV. = 320'

S = 5.33%

t_c = 2.92 HR.

Time of Concentration (Method #2)

by Kerby pg. 14-36 "Handbook of Applied Hydrology" Chow.

$$T_c = 2.14 \left(\frac{Ln}{\sqrt{S}}\right)^{2/3}$$

T_c = Time of Concentration in min.
L = Length of Overland flow in ft.
S = Slope
n = 0.4 (roughness Coef.)

Overland Flow:

L = 6,000'
S = 0.533
n = 0.40
t_c = 1.04 Hr.

Time of Concentration (Method #3)

N.J. Highway Authority Nomograph

Overland Flow:

L = 6,000'
S = 5.33 %
Avg. Grass
t_c = 0.90 Hr.

STORCH ENGINEERS

Sheet 3 of 13

Project Intervale Lake Dam Made By JLP Date 2-25-81

Chkd By JG Date 2/27/81

Time of Concentration (Method #4)

By pg. 71 "Design of Small Dams" Nomograph

$$T_c = \left(\frac{11.9 L^3}{H}\right)^{0.385}$$

T_c = Time of Concentration

L = Length of Longest Watercourse in miles

H = Elevation difference in feet

L = 6000'

H = 320'

t_c = 0.33 Hr.

Time of Concentration and Lag Time

T_c use 1.3 Hr.

Lag = 0.6 T_c = 0.78 Hr.

Precipitation

24 Hour - 100 year Rainstorm Distribution

For Intervale Lake Dam

Time (hr.)	Rain (Inches)
1	0.075
2	0.075
3	0.075
4	0.075
5	0.075
6	0.075
7	0.075
8	0.075
9	0.075
10	0.075
11	0.075
12	0.075
13	0.15
14	0.15
15	0.15
16	0.33
17	0.65
18	3.00
19	0.65
20	0.33
21	0.33
22	0.15
23	0.15
24	0.15
	7.12 Total

From TP40 U.S. Weather Bureau

STORCH ENGINEERS

Project INTERVALE LAKE DAM

Sheet 5 of 13

Made By JLP Date 2-25-81

Chkd By JG Date 2/27/81

ELEVATION - Storage Table

Information from U.S.G.S. Maps

ELEV. (M.S.L.)	Storage (Acre-ft.)
374.4	0
378.0	35.8
380.0	64.2
400.0	614.2

HEC-1-DAM Computer Program will develop storage capacity from storage volumes & elevations. Storage below elev. 374.4 due to lake dredging will not be included.

Information taken from USGS Quadrangle, Boonton, N.J.

HYDRAULICS

Stage Discharge Calculation

The Spillway at Intervale Lake Dam consists of a sharp crested timber weir with an effective length of 6.0', above which is a footbridge. Because of the footbridge Orifice flow will be taken into account at the appropriate elevation.

Orifice flow:

$$Q = 0.6\,(A)\sqrt{2gh}$$

Weir flow:

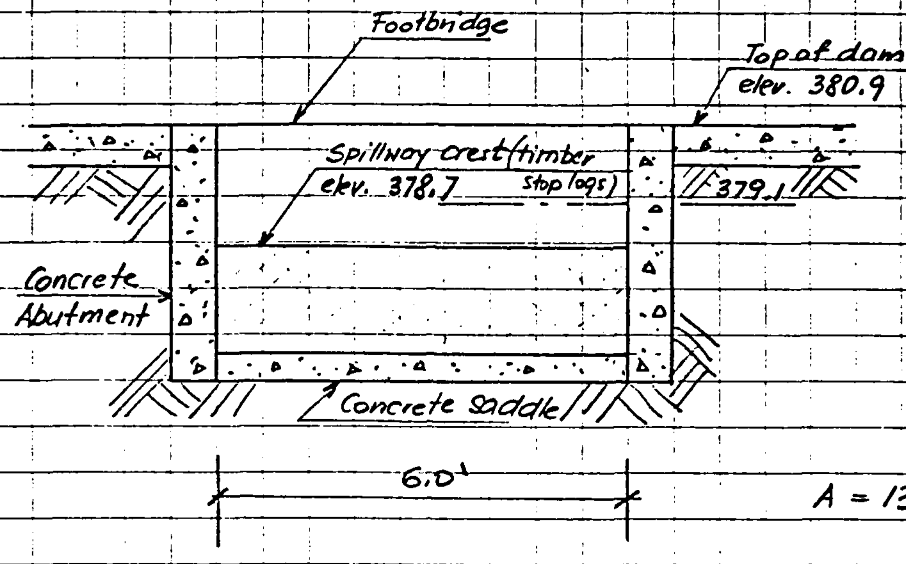
$$Q = CLh^{3/2}$$

For W.L. over 380.9, Orifice flow will control.

Project INTERVALE LAKE DAM Made By JLP Date 2-25-81

Chkd By JG Date 2/27/81

SPILLWAY SECTION



A = 13.2 [Sq ft.]

SPILLWAY

STAGE DISCHARGE TABULATION

ELEV. [Ft]	WEIR			ORIFICE		Q TOTAL
	H	C	Q	H	Q	
378.7	0	0	0			0
379.0	0.3	3.33	3.3			3.3
379.5	0.8	3.33	14.3			14.3
380.0	1.3	3.33	29.6			29.6
380.9	2.2	3.33	65.2	1.1	66.6	66.6
382.0				2.2	94.3	94.3
383.0				3.2	113.7	113.7
384.0				4.2	130.3	130.3

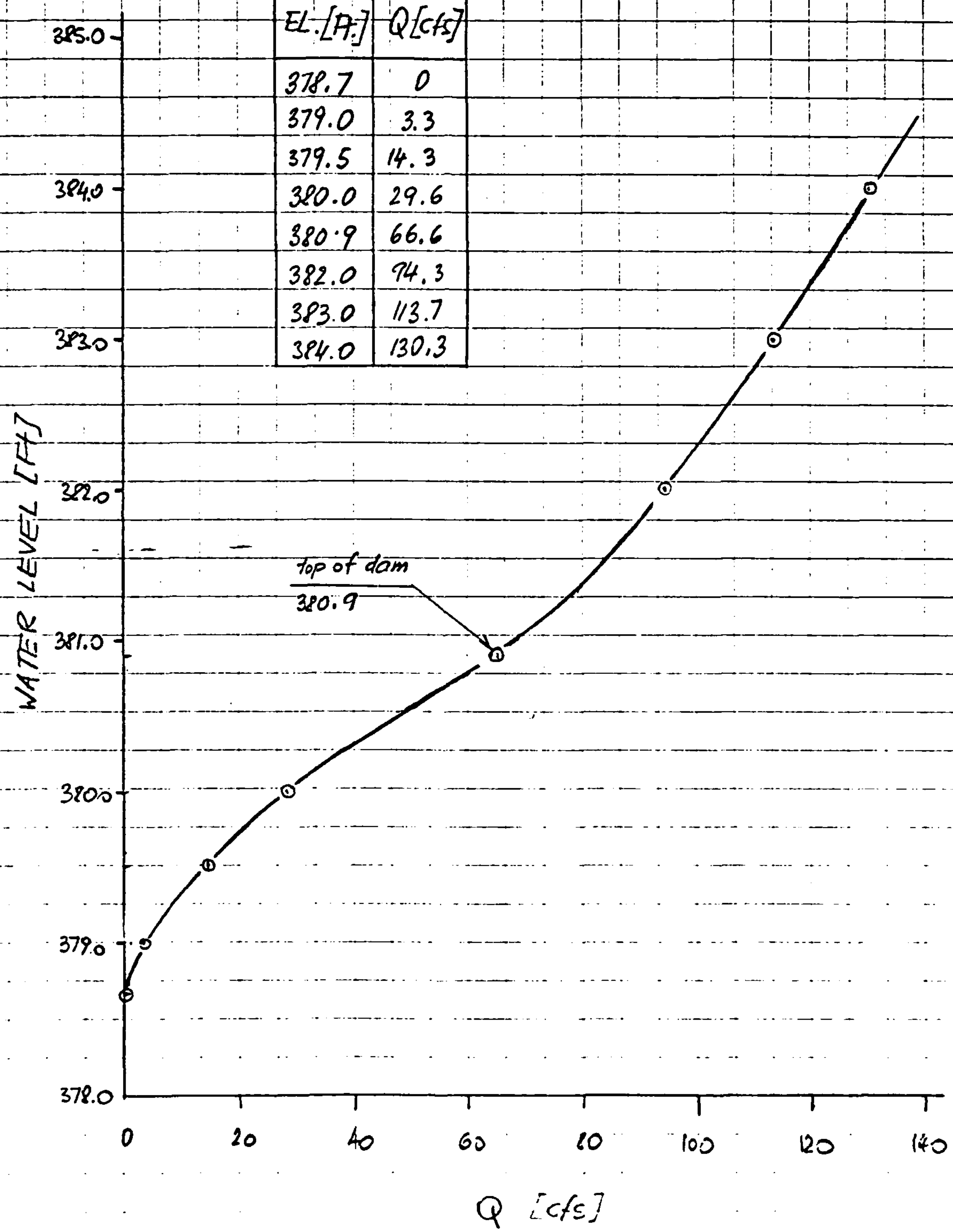
STORCH ENGINEERS Sheet 8 of 13

Project INTERVALE LAKE DAM Made By JLP Date 2-25-81

Chkd By JG Date 2/27/81

SPILLWAY STAGE DISCHARGE CURVE

EL. [ft.]	Q [cfs]
378.7	0
379.0	3.3
379.5	14.3
380.0	29.6
380.9	66.6
382.0	94.3
383.0	113.7
384.0	130.3



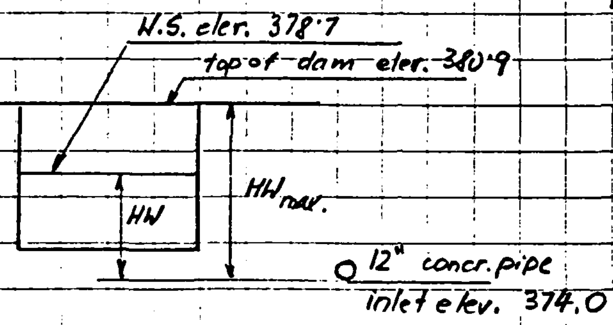
STORCH ENGINEERS | Sheet 9 of 13

Project INTERVALE LAKE DAM | Made By Jitta | Date 2-25-81

Chkd By JG | Date 2/27/81

DRAWDOWN:

[HCSC - Highway 5-22]



$d = 1.0'$

$HW = 3.7$ [Ft]

$HW_{max} = 6.9$ [Ft]

$\frac{HW}{D} = 3.7$

use nomograph

$\frac{HW_m}{D} = 6.9$

$Q = 7.2$ cfs $Q_{max.} = 10.0$ cfs

TIME OF DRAWDOWN:

$$T_d = \frac{\text{storage [Acft]}}{\text{discharge} - \text{inflow}}$$

(Assume inflow = 0)

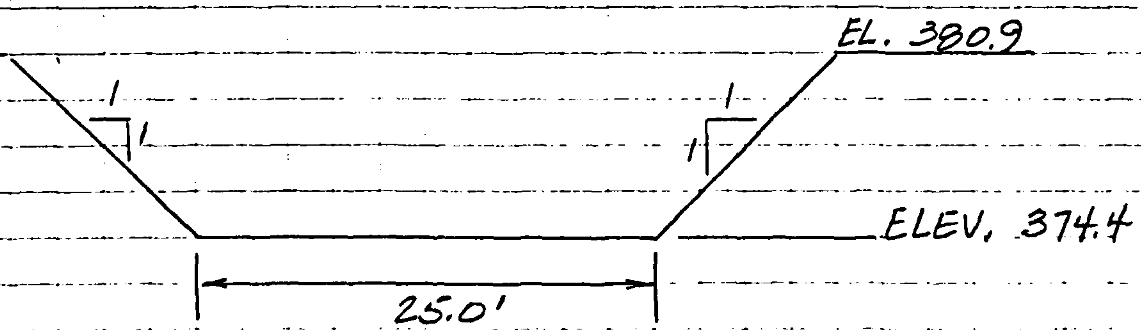
$$T_d = \frac{46 \times 43560}{7.0 \times 3600} = 79.5 \text{ Hr} = 3.3 \text{ days}$$

SQUARE 4 X 4 TO THE INCH

BREACH ANALYSIS

A BREACH HYDROGRAPH WILL BE COMPUTED BY THE HEC-1-DAM PROGRAM AND ROUTED THROUGH TWO DOWNSTREAM REACHES BY THE MODIFIED PULS METHOD. THE ASSUMED BREACH CONDITIONS ARE AS FOLLOWS:

1. THE BREACH BEGINS WHEN THE WATER SURFACE ELEVATION REACHES 380.9.
2. TIME TO DEVELOP BREACH = 1.0 HR.
3. SECTION



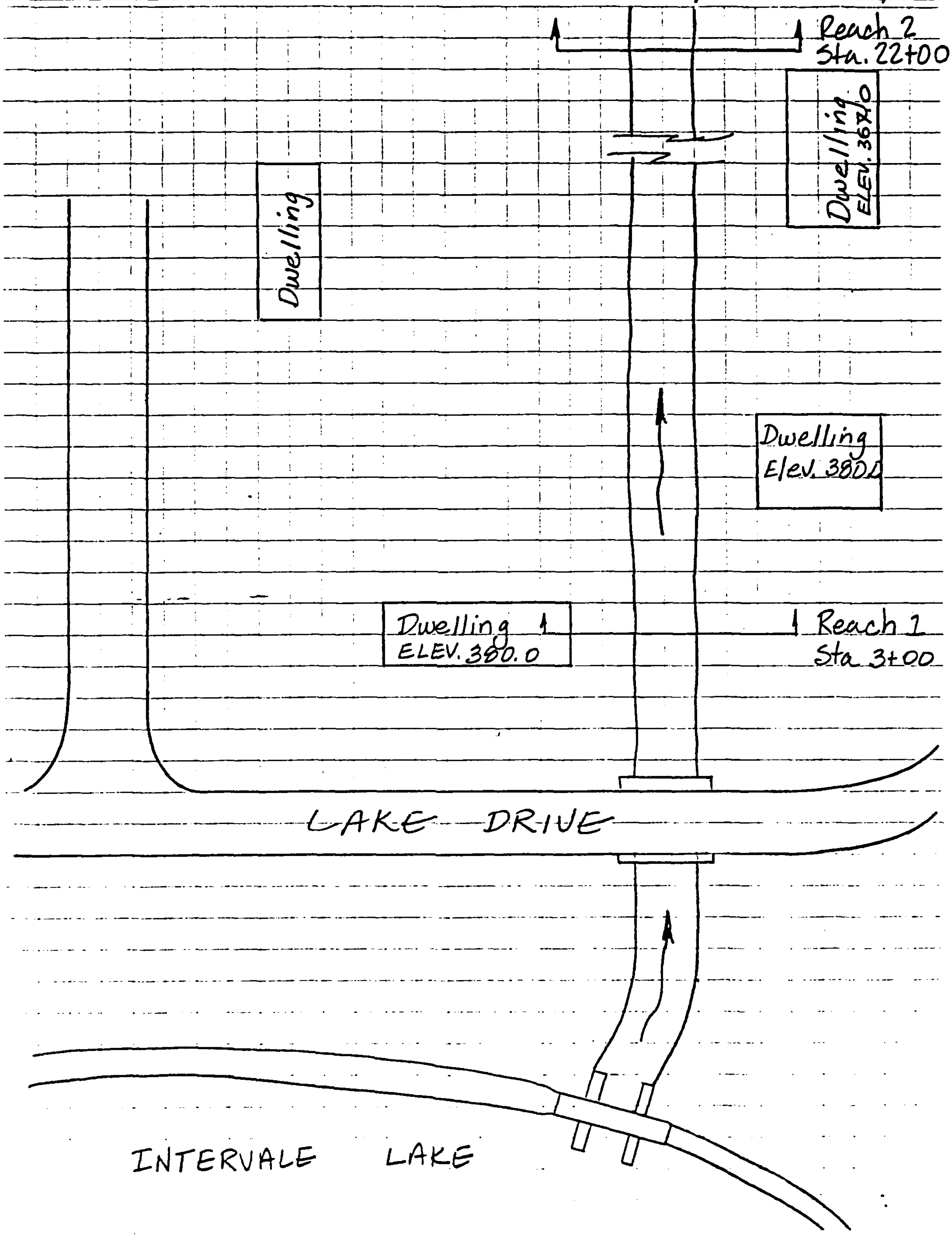
FULLY DEVELOPED BREACH

STORCH ENGINEERS

Sheet 11 of 13

Project Intervale Lake Dam Made By JLP Date 2-25-81

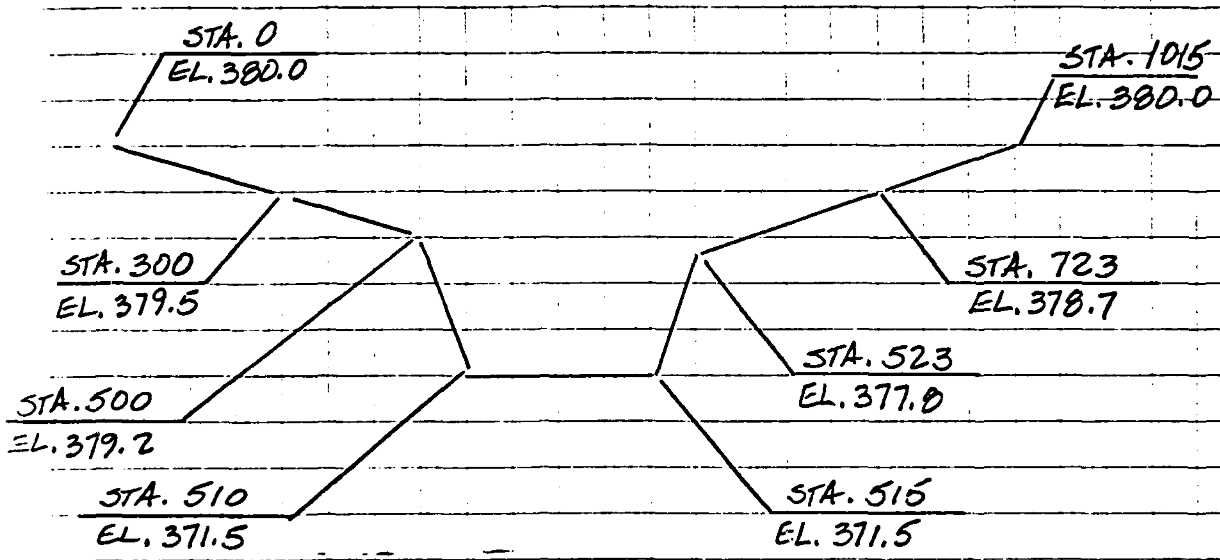
Chkd By JG Date 2/27/81



ect Intervale Lake Dam Made By JLP Date 2-25-81
Chkd By JG Date 2/27/81

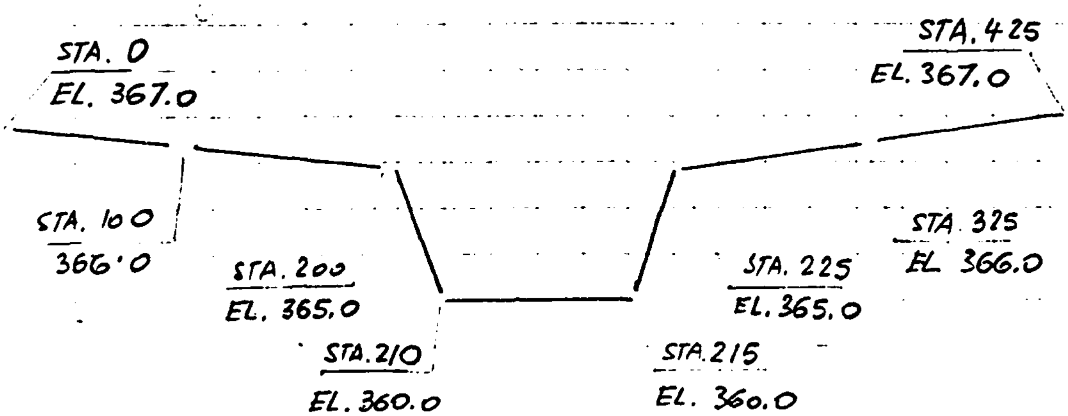
CROSS SECTION
END OF REACH 1

S = 0.0063 L = 300 [Ft]



CROSS SECTION
END OF REACH 2

S = 0.006 L = 1,900 [Ft]



STORCH ENGINEERS

Project INTERVALE LAKE DAM Made By JLP Date 2-25-81

Chkd By JG Date 2/27/81

BREACH RESULTS:

Peak outflow = 1340 [cfs]

Reach 1 stage - max. elev. = 379.3 [Ft]
inv elev. = 371.5 [Ft]

Dwellings not inundated

Reach 2 stage - max. elev. = 366.4 [Ft]
inv. elev. = 360.0 [Ft]

Dwelling not inundated

HEC - 1 - DAM PRINTOUT

Overtopping Analysis

```
A1       NATIONAL DAM SAFETY PROGRAM
A2       LAKE INTERVALE DAM, NEW JERSEY
A3         100 YEAR STORM ROUTING
B    300       0      15                               0       0       4
B1     5
J      1       1       1
J1     1
K      0    LAKE                       0       0       1
K1       INFLOW HYDROGRAPH TO LAKE INTERVALE DAM
M      0       2    0.53            0.53       0                       1
O     96
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019
O1 0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.019   0.038   0.038
O1 0.038   0.038   0.038   0.038   0.038   0.038   0.038   0.038   0.038   0.038
O1 0.083   0.083   0.083   0.083   0.163   0.163   0.163   0.163   0.750   0.750
O1 0.750   0.750   0.163   0.163   0.163   0.163   0.083   0.083   0.083   0.083
O1 0.083   0.083   0.083   0.083   0.038   0.038   0.038   0.038   0.038   0.038
O1 0.038   0.038   0.038   0.038   0.038   0.038
T                                                    1.5    0.15
W2          0.78
X   -1.0   -0.05     2.0
K      1     DAM
K1       ROUTE DISCHARGE THROUGH DAM
Y                              1       1
Y1     1                                          -378.7      -1
Y4 378.7     379   379.5     380   380.9     382     383     384
Y5     0     3.3    14.3    29.6    66.6    94.3   113.7   130.3
$S     0    35.8    64.2   614.2
$E 374.4     378     380     400
$$ 378.7
$D 380.9    2.63     1.5     120
K      1       1                                       1
K1       CHANNEL ROUTING REACH 1
Y                              1       1
Y1     1
Y6   0.1   0.035     0.1   371.5     380     300  0.0063
Y7     0     380     300   379.5     500   379.2     510   371.5     515   371.5
Y7   523   377.8     723   378.7    1015     380
K      1       2                                       1
K1         CHANNEL ROUTING REACH 2
Y                              1       1
Y1     1
Y6   0.1   0.035     0.1     360     367    1900   0.006
Y7     0     367     100     366     200     365     210     360     215     360
Y7   225     365     325     366     425     367
K     99
A
A
A
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NATIONAL DAM SAFETY PROGRAM
LAKE INTERVALE DAM, NEW JERSEY
100 YEAR STORM ROUTING

                                JOB SPECIFICATION
   NO     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
  300       0      15       0       0       0       0       0       4       0
                         JOPER     NWT   LROPT   TRACE
                             5       0       0       0

                   MULTI-PLAN ANALYSES TO BE PERFORMED
                        NPLAN= 1 NRTIO= 1 LRTIO= 1
RTIOS=    1.00

**********         **********         **********         **********         **********

                        SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO LAKE INTERVALE DAM
           ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
            LAKE       0       0       0       0       0       1       0       0

                              HYDROGRAPH DATA
   IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
       0       2     .53    0.00     .53    0.00   0.000       0       1       0

                                LOSS DATA
   LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
       0    0.00    0.00    1.00    0.00    0.00    1.00    1.50     .15    0.00    0.00

                           UNIT HYDROGRAPH DATA
                           TC=  0.00     LAG=    .78

                              RECESSION DATA
                 STRTQ=   -1.00     QRCSN=    -.05     RTIOR= 2.00

                             END-OF-PERIOD FLOW
     0
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q     MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q

                                                                    SUM   7.12   4.33   2.79   6352.
                                                                        ( 181.)( 110.)(  71.)( 179.87)
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     **********          **********          **********          **********          **********

                                        HYDROGRAPH ROUTING

                    ROUTE DISCHARGE THROUGH DAM

                           ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                             DAM       1       0       0       0       0       0       0       0
                                               ROUTING DATA
                   QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                     0.0   0.000    0.00       1       1       0       0               0

                           NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                               1       0       0   0.000   0.000   0.000   -379.      -1

STAGE      378.00      379.00     379.50     380.00     380.90     382.00     383.00     384.00

FLOW         0.00        3.30      14.30      29.60      66.60      94.30     113.70     130.30

CAPACITY=                 36.        64.       614.

ELEVATION=               378.       380.       400.

                     CREL   SPWID    COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                    378.7     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                                   DAM DATA
                                          TOPEL    COQD    EXPD  DAMWID
                                          380.9     2.6     1.5    120.

PEAK OUTFLOW IS      369. AT TIME  19.25 HOURS
```

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00
HYDROGRAPH AT	LAKE	.53 (1.37)	1	713. (20.19)(
ROUTED TO	DAM	.53 (1.37)	1	369. (10.45)(
ROUTED TO	1	.53 (1.37)	1	370. (10.46)(
ROUTED TO	2	.53 (1.37)	1	367. (10.38)(

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	378.70	378.70	380.90
STORAGE	46.	46.	89.
OUTFLOW	0.	0.	67.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	381.82	.92	114.	369.	5.00	19.25	0.00

PLAN 1 STATION 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	370.	376.5	19.25

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	367.	364.4	19.25

HEC - 1 - DAM PRINTOUT

Breach Analysis

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1A1       NATIONAL DAM SAFETY PROGRAM
 A2       LAKE INTERVALE DAM, NEW JERSEY
 A3          100 YEAR STORM ROUTING
 B     300         0        15                                          0         0         4
 B1      5
 J       1         1         1
 J1      1
 K       0      LAKE                             0         0          1
 K1       INFLOW HYDROGRAPH TO LAKE INTERVALE DAM
 M       0         2      0.53                0.53         0                                1
 O      96
 O1 0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019
 O1 0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019
 O1 0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019
 O1 0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019
 O1 0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.019     0.038     0.038
 O1 0.038     0.038     0.038     0.038     0.038     0.038     0.038     0.038     0.038     0.038
 O1 0.083     0.083     0.083     0.083     0.163     0.163     0.163     0.163     0.750     0.750
 O1 0.750     0.750     0.163     0.163     0.163     0.163     0.083     0.083     0.083     0.083
 O1 0.083     0.083     0.083     0.083     0.038     0.038     0.038     0.038     0.038     0.038
 O1 0.038     0.038     0.038     0.038     0.038     0.038
 T                                                              1.5      0.15
 W2            0.78
 X    -1.0     -0.05       2.0
 K       1       DAM
 K1       ROUTE DISCHARGE THROUGH DAM
 Y                                   1         1
 Y1      1                                                   -378.7        -1
 Y4 378.7        379     379.5       380     380.9       382       383       384
 Y5      0   3[illegible]     14.3      29.6      66.6      94.3     113.7     130.3
 $S      0      35.8      64.2     614.2
 $E 374.4        378       380       400
 $$ 378.7
 $D 380.9       2.63       1.5       120
 $B     25         1     374.4       1.0       378     380.9
 K       1         1                                            1
 K1        CHANNEL ROUTING REACH 1
 Y                                   1         1
 Y1      1
 Y6    0.1     0.035       0.1     371.5       380       300    0.0063
 Y7      0       380       300     379.5       500     379.2       510     371.5       515     371.5
 Y7    523     377.8       723     378.7      1015       380
 K       1         2                                            1
 K1          CHANNEL ROUTING REACH 2
 Y                                   1         1
 Y1      1
 Y6    0.1     0.035       0.1       360       367      1900     0.006
 Y7      0       367       100       366       200       365       210       360       215       360
 Y7    225       365       325       366       425       367
 K      99
 A
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**********          **********          **********          **********          **********

                              HYDROGRAPH ROUTING

              ROUTE DISCHARGE THROUGH DAM

                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                      DAM       1       0       0       0       0       0       0       0
                                        ROUTING DATA
              QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                0.0   0.000    0.00       1       1       0       0               0

                      NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                          1       0       0   0.000   0.000   0.000   -379.      -1

  STAGE     378.70    379.00    379.50    380.00    380.90    382.00    383.00    384.00

   FLOW       0.00      3.30     14.30     29.60     66.60     94.30    113.70    130.30

    CAPACITY=       0.       36.       64.      614.

   ELEVATION=     374.      378.      380.      400.

                   CREL   SPWID    COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                  378.7     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                            DAM DATA
                                  TOPEL    COQD    EXPD   DAMWID
                                  380.9     2.6     1.5     120.

                                             DAM BREACH DATA
                          BRWID       Z    ELBM   TFAIL    WSEL  FAILEL
                            25.    1.00  374.40    1.00  378.00  380.90

 BEGIN DAM FAILURE AT 18.50 HOURS

 PEAK OUTFLOW IS     1340. AT TIME  19.50 HOURS


**********          **********          **********          **********          **********
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RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00
HYDROGRAPH AT	LAKE	.53 (1.37)	1	713. (20.19)(
ROUTED TO	DAM	.53 (1.37)	1	1340. (37.94)(
ROUTED TO	1	.53 (1.37)	1	1288. (36.49)(
ROUTED TO	2	.53 (1.37)	1	1136. (32.16)(

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	378.00	378.70	380.90
STORAGE	36.	46.	89.
OUTFLOW	0.	0.	67.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	381.35	.45	101.	1340.	1.00	19.50	18.50

PLAN 1 STATION 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	1288.	379.3	19.50

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	1136.	366.4	19.75

APPENDIX 5

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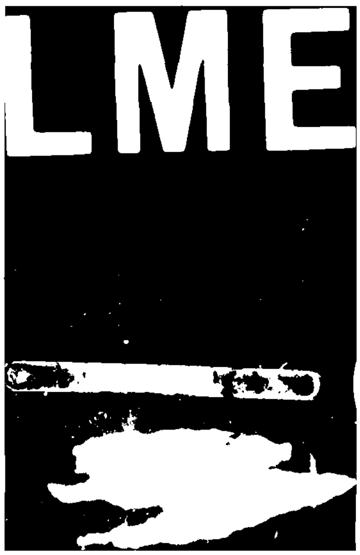
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